The Northwestern MILLER
MILLING PRODUCTION SECTION

The Penetration of Moisture Into the Wheat Kernel

By Gordon M. Grosh and Max Milner
Kansas State College

Is a study of the penetration of water into the wheat kernel a problem of concern to the miller, or is it simply one to catch the interest of the research worker with practical applications about as useful to the milling industry as counting sea shells on the sea shore?

An examination of this question leads to some understanding of the basic principles involved in the ever-so-important practices of tempering and conditioning. The main object of conditioning is to bring the wheat into the physical state most suitable for milling. Wheat mills best when its content and distribution of moisture are such that the bran remains tough, the endosperm crumbles and comes easily away from the bran, and the stock is lively and easy to sift. Attainment of the right moisture level is more of an art than a science. The miller has had to tax his skills and experience to determine the optimum conditioning of his grain.

Recently, with the increasing practice of milling mixed grains, the problem of moisture preparation has become extremely complex. Basic principles are involved which guide the miller's actions despite the fact that he may not actually know what they are. It is the job of the research worker to figure out these principles so the conditioning and milling processes may be as logical and efficient as possible.

McCluggage (17) in 1940, attempted to summarize the more prevalent theories concerning conditioning.

(a) At first, it was believed that adding water to wheat was beneficial solely because it produced a tougher bran in milling (Kick (14), Kozmin (15), and Bailey (2)).

(b) Others felt that tempering produced certain chemical effects that altered the milling properties. This is as questionable today as it was in the 1920's (Williams (24), Scott (20), Workman (25)).

(c) At present workers feel that though there may be slight chemical changes occurring in conditioning, the main benefit is due to changes in the physical properties of the processing material. Along with a tougher bran, is noted an increased "mellowness" of the endosperm which promotes more favorable separation from the bran.

There is no doubt that these physical changes involve the movement of moisture into the grain. What then, is known about this movement, its path and its rates?

Much indirect evidence can be gained by observing the change in moisture content of wheat under various wetting conditions. Pence and Swanson (19) found when wheat was immersed in water, (Fig. 1) it picked up water rapidly at first (7-10% within the first 10 minutes at room temperature). The rate of absorption decreased with time.

In the first two minutes temperature had little effect on absorption, but afterward absorption increased very markedly with an increase in temperature. The permeability of the bran coat was also studied by coating different portions of the wheat surface with shellac to prevent moisture penetration through that particular part of the kernel. Grains shellacked at the brush end absorbed as much water as untreated grains. Those shellacked on the germ and back end absorbed less moisture but enough to indicate considerable absorption in these regions. This led the authors to the conclusion that water is absorbed not only at the germ end but also on the entire bran surface.

Jones (12) classified water absorption into three phases:

(a) A rapid initial uptake period corresponding to the immediate seizure of water by the bran which is much more hygroscopic than the endosperm.

(b) A period during which moisture pickup decreases rapidly.

(c) A period during which the moisture absorption is steady but slow. An almost linear relationship between moisture content and time can be shown for this period.

Jones also confirmed Swanson's observations that the initial stages of penetration are not affected by temperature change.

What work has been done to actually permit observation of the movement of moisture into the wheat? Various techniques have been developed to achieve this end. Haltmeier (10) wetted the grain with potassium sulfocyanide solution, cut a section of the kernel and sprayed the cut surface with ferric chloride, thus developing a red color in those parts where the sulfocyanide had penetrated.

Initial penetration took place at the micropile (junction of wheat grain to the plant stalk) on the outer edge of the germ and endosperm, where the aleurone layer begins. The solution slowly moved immediately beneath the bran towards the brush end and at a much slower rate into the interior of the endosperm. However, after moving halfway up, penetration slowed down markedly.

Haltmeier attributed this cessation in movement to the formation of a starch-sulfocyanide complex which

(Continued on page 19a)

EDITOR'S NOTE: Much information has been obtained in the past few years concerning what happens in the wheat kernel during tempering and conditioning. And many millers will be interested in the accompanying article, which is a review of literature dealing with the penetration of moisture into the wheat kernel. However, the authors also point out, "there still is much ground work to be done before the miller can hope to change the art of grain tempering to a science." This article is Contribution No. 261, Department of Flour and Feed Milling Industries, Kansas State College, Manhattan. The paper was presented by Mr. Grosh at the 1955 technical conference of the Association of Operative Millers in St. Louis. This literature review is a portion of a thesis to be presented by Mr. Grosh as partial fulfillment of the requirement for the degree of doctor of philosophy in the Department of Flour and Feed Milling Industries at Kansas State. Mr. Grosh is a research assistant and Dr. Milner a professor in the department.

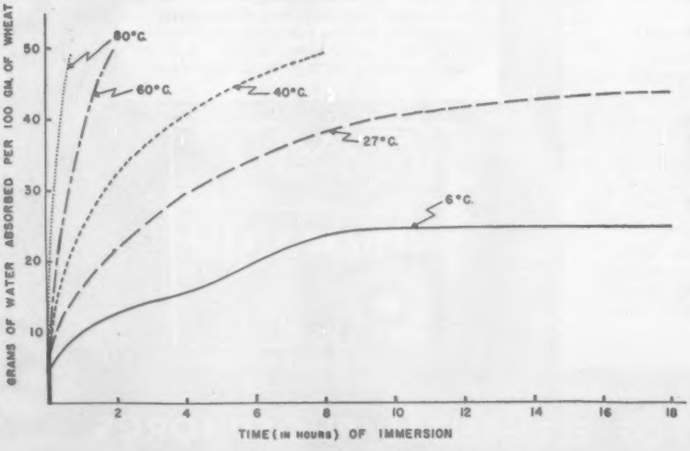

FIGURE 1—Effect of temperature and time on moisture absorption by whole wheat grains (Data of Pence and Swanson, 19).

FIGURE 2—Diagrammatic representation of mode of penetration of iodine vapor into wheat with wetting. The appearance of various stages (stadien) at various hourly intervals (stunden) is indicated (Data of Ugrimoff, 23).

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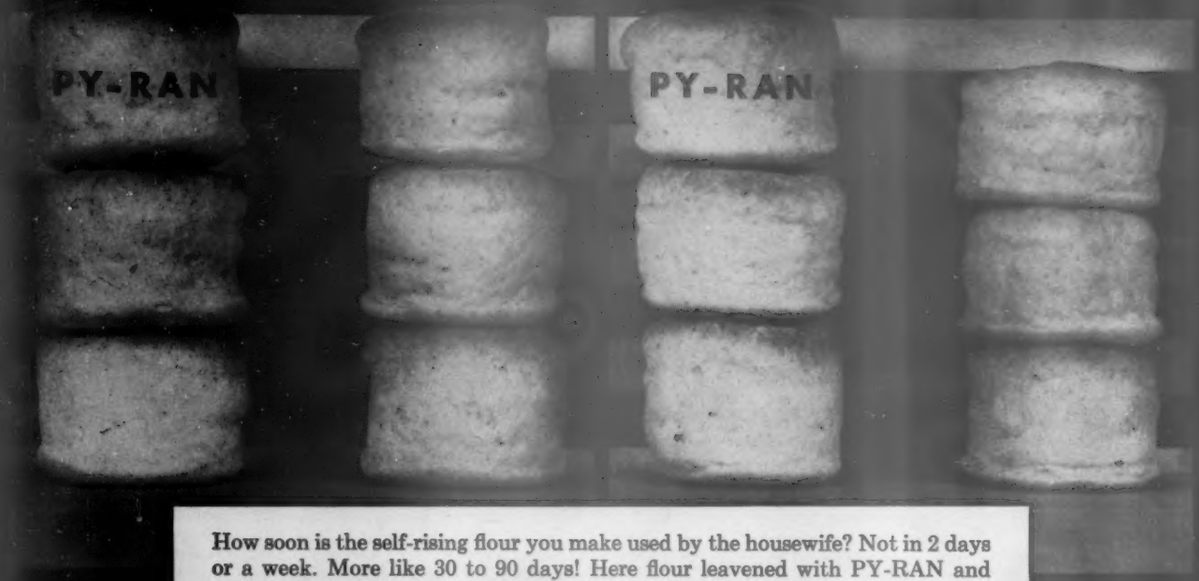

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TRANSPORTATION

Milling-in-Transit and What It's All About —Problems and Progress in Traffic Operations and Transportation in the Industry

By J. R. Staley
The Quaker Oats Co.

EDITOR'S NOTE: Milling-in-transit privileges in connection with rail transportation in grain processing industries are regarded by many persons as a pretty complicated thing and somewhat of a mystery. However, says the author of the accompanying article, while milling in transit does have its complications, it is not the mystery which some persons have made it out to be. Mr. Staley devotes most of the material in this article to discussing milling in transit, noting its importance and showing that in both principle and practice it is relatively simple. He also covers other aspects of traffic operations in the industry, and he discusses new developments and needs in transportation. Many men in milling companies who are not directly concerned with traffic work and freight rates will find this clear and informative article of considerable interest and help. The article is the text of a talk by Mr. Staley at the 1955 conference of the Association of Operative Millers and is reprinted from the AOM Bulletin. Mr. Staley, a traffic authority who is well known in the grain processing industry, is vice president of the Quaker Oats Co.

Actually, the transportation function in the milling industry is distinguishable from transportation generally only in two regards. First, the ratio of transportation charges to the sales price of our finished products is much higher than it is for most other manufactured goods. Transportation charges constitute an almost insignificant ingredient of the retail selling price of articles such as electrical appliances, sewing machines, shoes, and other wearing apparel. But in our industry they represent 15% to 20% of our operating cost.

At the risk of employing a cliche I must also say the milling industry is a highly competitive one; a difference of ¼¢ per bushel can control the sales of grain, while 1¢ a barrel is sufficient to divert the sale of flour. Thus, transportation assumes a role of unusual importance.

The second important distinguishing characteristic is the availability, the wide-spread use, and indeed the utter dependence of the industry upon milling-in-transit privileges. While milling-in-transit does have its own little complications, it is certainly not the mystery which some of us in the traffic fraternity have made it out to be, and I want to take most of my space here discussing it so you cannot only appreciate its importance, but also see that in both principle and practice it is relatively simple.

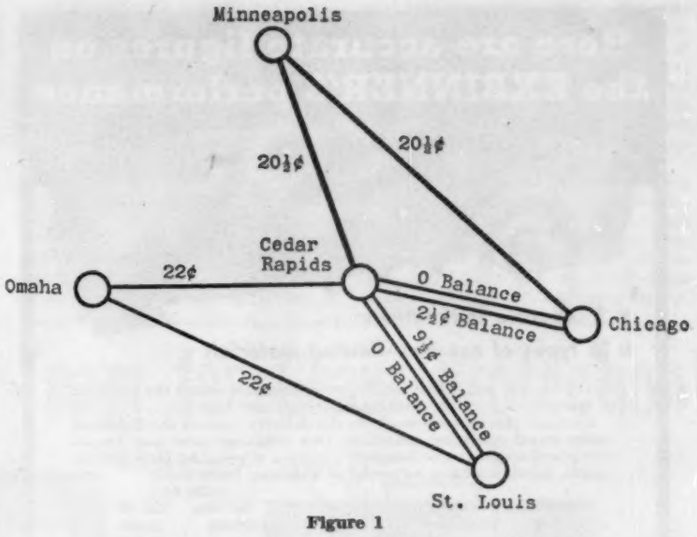

Figure 1

The essence of milling-in-transit arrangements is to make every milling location along the line of transit between the origin of the grain and the ultimate consumer of the grain product competitive.

Railroad Costs

The first thing to understand is that railroad rate scales are not constructed on a straight-line progression. To do so would be unrealistic, as railroad costs consist very largely of fixed or constant expenses which do not vary directly with the length of haul. Among these expenses are the billing, auditing, and other clerical costs which generally are the same for a 10-mile shipment as they are for a 1,000-mile shipment.

Another group of relatively fixed costs might be described as terminal expenses. They include cleaning and placing cars for loading, switching them from industry to yard, classifying them according to destination and train, and getting them on the way.

Third, we must consider the capital burden. It is characteristic of the railroad industry that the ratio of revenues to capital investment is ex-

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XB24	ground oats	280	20,800
XB24	bran	170	10,000
XB24	pellets (checkers)	570	34,200
XB48	ground corn	1600	96,000
XB48	mids	670	40,200
XB48	bone meal	1440	86,400
XB48	tankage	1500	90,000
XB48	soybean meal	1400	84,000
XB48	corn gluten feed	1100	66,000
XB48	flax screenings (light)	600	36,000
XB48	alfalfa	500	30,000
XB48	ground screenings (light)	600	36,000
XB48	bran	1100	66,000

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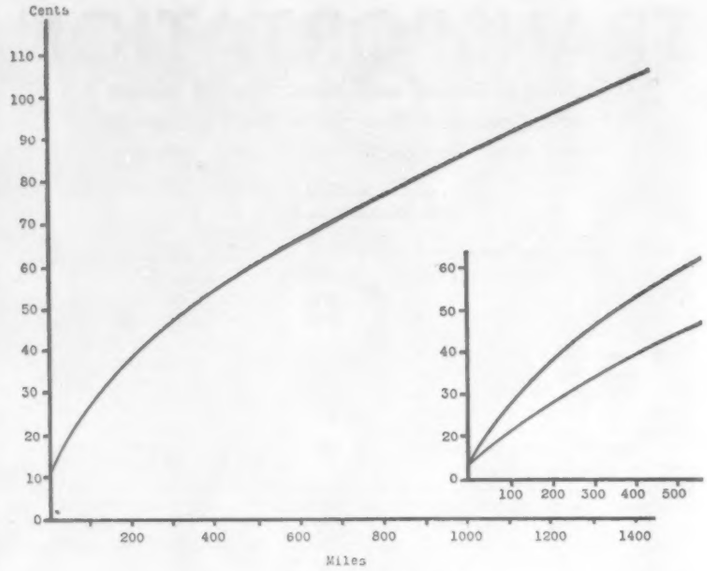

Figure 2

tremely low, and depreciating and servicing this huge investment constitutes another significant non-variable expense.

With today's modern motive power and improved roadbeds, the expense of actually moving freight in a train has become almost a minor element of cost.

To reflect the impact of these fixed or constant costs, railroad rate scales begin with a high initial or minimum charge, progress rather abruptly through the first few mileage blocks, and then taper off in some cases almost to a horizontal plane. Thus, you will notice from Figure 1, depicting the rate scale applying on grain in the South, that for the first 200 miles there is a charge per 100 lb. of 39¢; for the second 200 miles, i.e. the distance between 200 and 400 miles, the additional charge is only 15¢; and for the 200 miles between 1,200 and 1,400 the additional charge is only 9¢.

Combination of Distances

It is obvious that charges based on a combination of rates for any two distances would be higher than the single rate resulting from applying the scale to the combination of distances. Thus, the rate for two 400-mile hauls is 108¢, while for one 800-mile haul it is 75¢.

Without milling-in-transit arrangements, the only mills which could compete on a basis of transportation charge equality would be those located at the source of the grain or at the final destination of the product. Cincinnati is not a very likely grain producing area, but if for the sake of example we use it, and choose Jacksonville, Florida, as the consuming point, it appears a mill located at Cincinnati would pay the 75¢ through rate to get its product to Jacksonville.

Since the rates on grain and the products thereof are, with few exceptions, the same, a mill located at Jacksonville would be competitive transportation-wise because it would also pay 75¢ for transportation of the whole grain from Cincinnati. Anywhere else along the line between Cincinnati and Jacksonville, however, a mill would be subjected to transportation charges penalties.

A mill at Nashville, for example, would pay 44¢ to have the whole grain moved from Cincinnati to the mill and then pay 67¢ for moving the finished product on to Jacksonville, or 36¢ more than either the Cincinnati or Jacksonville miller.

Protection of Through Rate

If the essence of milling-in-transit arrangements is equalization of competitive factors, the principle of it is protection of the through rate. Reverting again to the miller at Nashville (and it is appropriate to use this for it was at Nashville in 1863 that the first milling-in-transit arrangement in the U.S. was established) under a normal milling-in-transit arrangement, the Nashville miller would pay 44¢ for the transportation of the grain from Cincinnati.

The milled products would then be forwarded on to Jacksonville not at the 67¢ local or flat rate, but at 31¢, the balance of the through rate applying from Cincinnati to Jacksonville. In other words, the miller would be given credit for the 44¢ paid in rate just as you might be credited for an advance payment in a department store on a lay-away plan. The total charges of the Nashville miller have, through the operation of milling-in-transit arrangements, been made the same as his competitors at Cincinnati and Jacksonville.

This then is milling-in-transit; and if we were dealing only with direct routes along straight lines, such as we show here from Cincinnati to Jacksonville, there wouldn't be much of a story to tell. However, because railroads themselves are competitive we have rates applying between two points over literally millions of routes.

For example, between Dallas, Texas, and Detroit, Michigan, there are 4,717,667 authorized routes. Over every one of these routes the same rate applies. Obviously some are much longer than others and they pass through points considerably off the tangent from Detroit to Dallas. In instances where we have angular or "L" shaped—perhaps even "V" shaped—routes, there are legitimate opportunities to apply inbound billing in such a way as to produce lower freight charges than would result from merely paying the balance of rates over the direct route.

Example Cited

Figure 2 provides a relatively simple illustration of this point. The rate from Minneapolis to Chicago is the same over routes operating

through Cedar Rapids, Iowa, as it is over the direct route, and the charge from Minneapolis to Cedar Rapids, incidentally, is the same as it is to Chicago. Thus it costs nothing to ship products milled from Minneapolis grain from Cedar Rapids into Chicago. At the same time we have a similar condition in connection with Omaha and St. Louis. Obviously, our traffic department, to the extent it can, will always use the Minneapolis credit on shipments to Chicago, and the Omaha credit on shipments to St. Louis.

This is only an elemental example. To apply transit billing properly, day-in-and-day-out, requires imagination and inspiration as well as meticulous knowledge of the rate schedules. I have often told the traffic men in our mills that, except for the milling-in-transit phase of their work, their jobs could be done by little girls.

This practical effect of transit arrangements means the activities of the traffic department in a milling concern must be closely integrated with those of the grain purchasing department. In our office the traffic department was deliberately assigned a location close by the grain department, and there is constant liaison between the two.

Saving Money

I recall once when I was late getting out to lunch, the manager of our grain department came in to say he had Omaha on the telephone and wanted to give them routing on 100 cars of oats which he was purchasing to go to our mill at St. Joseph, Missouri. I asked why he bought the oats at Omaha instead of Minneapolis and he informed me they were 1½ cents per bushel cheaper. I explained that Minneapolis billing was worth 20½¢ per 100 lb. more than Omaha billing on shipments to the Pacific Coast, and fifteen minutes and two telephone calls later we had saved $32,000 in freight charges simply by switching this grain order.

I use this example because, at least to me, it was a dramatic illustration of the absolute necessity for close co-ordination between the traffic department and the other departments in a milling concern; but it is only typical of what goes on day after day in our office. Every purchase of grain involves conferences with the traffic department, and very frequently it will be decided to pay a somewhat higher price for grain at one location as opposed to another because of the difference in value of the transit billing to be furnished.

The very existence of milling-in-transit is a source of much controversy, primarily, I think, because it is much misunderstood both within and without our industry. Opinions range all the way from those who seriously contend the industry couldn't have developed without transit to those at the other pole who insist transit is wicked, sinful, and unlawful per se.

Matter of Practicality

To me, it is simply a matter of practicality. Transportation charges on grain are on a level which takes cognizance of transit arrangements. Therefore, we do not get something for nothing. I am sure that when we started out, transit was not indispensable. Today, however, billions of dollars have been invested in consideration of transit.

It has been said the two impossibilities are unscrambling an egg and getting back your virginity. To this I add a third—the elimination of milling-in-transit arrangements.

These transit arrangements also contribute to one of the big transportation headaches of our industry—paperwork. Method-conscious engineers would recoil with horror from some of the inane, insane paper work done in mill traffic departments.

Contributing to our red-tapestry is the mixed-carload shipment, which—though not peculiar to the milling industry—seems to be more prevalent in it than in other manufacturing endeavors. Manufacturers of full lines of cereal products frequently include 20 or 30 different items in one car, and almost every shipment of mixed feed contains several different varieties. The physical handling of these mixed shipments is complicated somewhat by the necessity of making several counts to insure accurate loading, but the major difficulty arises from the paper work involved in connection with transit. Fortunately, some progress is being made in this area.

Mixed Feed

Each item of mixed feed contains many different ingredients, most of which are entitled to transit, and each individual feed is made to its own formula. Not so many years ago we separated each mixed carload of feed into the various brands or types, applied the correct formula to each to determine how many pounds of wheat, how many pounds of corn, how many pounds of oats, soybean meal, and all the other ingredients were in the car. It literally took hours to do the paper work in connection with each car of feed.

It dawned on us that in the long run we actually got the same results if we simply used an average formula on all the feed shipped. After considerable negotiation and discussion and—believe it or not—objections from within the feed milling industry,

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we prevailed upon the railroads to establish the now widely used master formula rule, under which billing is applied on the basis of the mill consumption of ingredients for a previous 90-day period.

Another land-mark in the evolution toward common sense in paper work was the adoption of so-called unit billing rules on mixed feed and in connection with certain special situations. I will not burden you with a detailed discussion of the unit rule other than to say it again involves the law of averages and permits the use of a credit on any one kind of grain where there are mixed outbound shipments rather than having meticulously to apply oat billing against oats, corn billing against corn, etc.

The effect of some of these modern methods is phenomenal. Under the old system it used to take the traffic department at our Portland, Ore., mill four hours to bill a mixed car shipment; under the new method they can do it in less than 15 minutes.

Freight Claims

The prevalence of mixed car shipments in the milling industry also contributes to freight claim complications. Despite the continuous efforts we make to improve loading methods, we find there is more likely to be damage when there are several different sizes and shapes of containers in a car. Here again, though the major difficulty is not physical in nature but involves paper work—that great symbol of civilization.

We file a great many claims every year—more than we would like to—and I recall when I first came with Quaker we had eight people working full time in our claim department. One man did nothing all day long, all year long, but laboriously copy invoices covering shipments and apply to the copies a rubber stamp certifying their corrections. He retired a few years ago, and in his place we have a simple printed sentence on the bottom of each claim form, "This is to certify the prices used in this claim are correct invoice prices."

The traditional practice was to have the traffic department write the claim up in rough pencil form and send it back to our stenographic department, where all the lines and boxes were filled in. In accordance with instructions which had been observed for 40 years, we put on the claim the corporate name of the railroad, name of the claim agent, the location of his office, and almost every available piece of information about the shipment, including car number, route, consignee, shipper, and the color of the stenographer's hair who made out the bill of lading.

Now we have at the top of our claim form the abbreviations for the railroads with which we regularly file claims. One simple check mark sends the claim spinning on its way to the AT&SF just as expeditiously as if we had addressed it to Mr. H. W. Gentle, Freight Claim Agent, Atchison, Topeka, and Santa Fe Railway Company, 80 East Jackson Boulevard, Chicago 4, Ill.

Next we asked ourselves and the railroads why we should copy from the freight bill to the claim form all the information about the shipment when the freight bill itself was attached to the claim form. Since no one had an answer, we stopped doing it.

For year after year we have had our sales offices writing a special claim form on which they listed each item of the mixed carload shipment which was damaged. This came to the claim department and from it a journal entry was prepared to enable the accounting department to credit the customer. From a copy of the journal entry the stenographic department would then transcribe to the claim the same description.

It took years to change this thing completely, but now the sales department simply makes the journal entry in triplicate in lieu of its special claim form, and we merely attach a copy of the journal entry to the claim instead of copying all the information on it.

It is an actual fact that we can now file a claim with about four scratches of a pencil, and we have taken the stenographic department out of the picture completely.

Our business has increased and, unfortunately, our claims have too. But we manage to get them all filed with three people where eight years ago we had eight.

There have been a number of interesting developments in the transportation equipment we use in the milling industry. The covered hopper, the Trans-Flo car, the Air-slide car, the very new container car developed by Shippers Car Line, the rubber balloon containers, and other such developments, all intended to increase the efficiency of handling and loading grain products—especially flour.

More Improvements Needed

While the past few years have brought some major improvements in transportation equipment and the promise of others to come, it is the sad truth that transportation has not kept pace with the trend toward automation generally in the milling industry. It is inevitable that more improvements must be made in transportation equipment and they must come much faster than they would at the comfortable pace to

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which our transportation industry has accustomed itself.

The era of bulk handling is already here and as facilities and equipment are modified there is no doubt the quantity of materials moved in bulk will vastly increase. This is a condition which transportation agencies must be prepared to meet.

We have already found that our customers today demand faster and more frequent shipments in order to keep their inventories at as low a level as possible. This has necessitated an increasing use of warehouse and distribution facilities. As we move, either voluntarily or under duress, toward a guaranteed annual wage plan, more warehousing is inevitable. With increased warehousing comes increased handling and these additional costs must be overcome by mechanization and automation. After several years of dragging their feet, the railroads now appear to be on the brink of providing free transportation for pallets. There still remains the problem of returning the empty pallets but no doubt that too will be solved.

Another development of great significance is the rebirth of water transportation. While never quite dead, water transportation for decades was rendered dormant in most areas of the country by the availability of superior railroad service. The technological improvements in barges and propulsion units, the improvement in waterways by the government and the high level of railroad freight rates have all combined to awake this sleeping giant. Today we are witnessing the transportation of increasing quantities of grain on the once non-navigable Missouri River. Huge grain elevators are springing up on the Tennessee River and the whole milling industry is being forced to look toward water in making any expansion plan.

All of these developments point up the responsibility of those in charge of transportation in the milling industry to coordinate their efforts with those of the engineers.

In our company we have always worked closely with our engineering department and with the tremendous changes which the next few years promise to bring in transportation facilities and practices, we are going to be more and more dependent upon engineers and their blueprints and slide rules.

—BREAD IS THE STAFF OF LIFE—

AACC Plans World Wide Symposium

NEW YORK—An international symposium on cereal grains is to be held in connection with the next annual meeting of the American Association of Cereal Chemists which is scheduled to be held in New York in May, 1956.

The symposium will cover the problems of planting, harvesting and utilizing cereal crops. Areas of significance, considered as suitable for papers, include the problems of wheat and other grain genetics, soil agronomy, insect control, fertilization, harvesting, storage, milling, baking, and chemical and physical research on any of these problems.

The project, it is hoped, will bring together, possibly for the first time, many scientists engaged in aspects of supplying a significant, if not the most significant, portion of the world's food to exchange ideas, practices and knowledge.

Advance announcements of the symposium have appeared in trade and scientific journals in various parts of the world in an effort to attract a representative collection of papers. AACC, it is explained, does not have sufficient funds to finance the whole of the program but it is suggested that the institutions, governments and other organizations sponsoring such research might wish to send representatives to the meeting.

Those wishing to present papers should communicate with Gaston Dalby, Ward Baking Co., 367 Southern Boulevard, New York 54, N.Y.

D. S. Prideaux Heads Lone Star Chemists

LAKE MURRAY, OKLA. — D. S. Prideaux, Morrison Milling Co., Denton, Texas, was elected chairman of the Lone Star Section of the American Association of Cereal Chemists at a meeting Sept. 16-17 at Lake Murray.

The election took place at a chemists' business session in connection with a joint meeting of the Lone Star Section and District No. 7 of the Association of Operative Millers.

As chairman of the chemists' group, Mr. Prideaux succeeds Dr. Wendell Reeder, Campbell-Taggart Associated Bakeries, Inc., Dallas.

Eugene Vickers, Alva (Okla.) Roller Mills was elected vice chairman, and Walter J. Rudy, Merck & Co., Inc., continues as secretary.

During the speaking program Sept. 17, A. A. Rolfe, Quaker Oats Co., Sherman, Texas, told of x-ray techniques for detecting infestation in grain, and S. E. Detlaff, Allis-Chalmers Manufacturing Co., Milwaukee, described the operation of a pneumatic mill.

A panel discussion covered new wheat crop characteristics. Moderators were Dr. Reeder and Ben Blackburn, Fant Milling Co., Sherman.

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Symposiums on Milling, Cereal Problems Featured by American Chemical Society

MINNEAPOLIS—The 128th meeting of the American Chemical Society held in Minneapolis recently covered a wide field of technical interest. Of the many papers presented, only a few were of immediate interest to the flour milling industry. Of major importance, however, was a symposium on marketing problems in the milling industry. Malcolm M. Renfrew, Spencer Kellogg & Sons, Inc., presiding over the symposium, pointed out that the lowest cost manufacturing methods are necessary for the survival of the industry, coupled with the development of new products and services. Chemistry has helped to shape the course of this change, Dr. Renfrew declared. In the symposium on cereals Dr. Betty Sullivan, vice president, Russell-Miller Milling Co., presided. Following are summaries of papers presented:

R. C. Sherwood, Sterwin Chemicals Inc., described a way of marketing chemical agents. Mr. Sherwood said that maturing and bleaching of wheat flour is an essential operation in the production of flour designed to yield the kinds of baked goods most consumers want. Such flour treatment was begun in flour mills more than 50 years ago and has continued without interruption. The chemical agents used by flour millers are only those listed as permitted optional agents in the federal definitions and standards of identity for wheat flours.

Marketing of the agents has undergone a distinct change since the inception of bleaching, although changes in number and chemical composition of the bleaching agents have been relatively few, Mr. Sherwood explained. The most recent innovation is the introduction of chlorine dioxide hydrate which by simple manipulation provides the flour miller with chlorine dioxide gas for maturing and bleaching. Previously the miller had to operate a chlorine dioxide generator to obtain the gas.

Mr. Sherwood listed the agents commonly used for bleaching and maturing, mentioned their interrelations, and described the system of marketing the agents which involves selling a complete flour treatment service to flour millers.

Automation

Robert J. Hoskins, the Safety Car Heating and Lighting Co., Inc., in association with Robert B. Dodds of the same company, called his paper, "Selling New Equipment to an Old Industry." Mr. Hoskins said, "Automation is currently the word of the hour, yet the flour milling industry has practiced principles of automation for over 50 years in its process of milling flour. Flour milling, in fact, is believed to be the very first continuous production process."

The reasons for this industry temporarily releasing its position of dominance in modernization were discussed by Mr. Hoskins. He explained that the Entoleter Division of Safety Car Heating & Lighting Co. faced the problem of marketing infestation control equipment at the outset to an industry suffering from a declining market for its product and overproduction. Methods employed to "break" resistance against accepting a new concept in infestation control and grain cleaning were outlined.

Diversification of the line of Entoleter centrifugal machines to include mixers, hullers, impact mills, aspirators and finally entry into the dust collecting field to increase volume, thereby making possible suitable field representation not only in flour milling but also in the basic process industry, were described.

Wheat Deterioration

Dr. W. F. Geddes, Department of Agricultural Biochemistry and of Plant Pathology and Botany at the University of Minnesota, in association with C. M. Christensen and L. S. Cuendet, described some biological and biochemical aspects of wheat deterioration to open the symposium on cereals.

The paper indicated that it has been repeatedly demonstrated that fungi are a dominant factor in spoilage of wheat stored above about 14.5% moisture. Recently Aspergillus restrictus, a member of the A. glaucus group, was shown to invade wheat stored in the laboratory at moisture contents of 13.5 to 15% for 16 months. The fungus grew slowly and was prevalent in the germs of commercial samples in which "sick" wheat had developed. Invasion of wheat by molds during periods of high moisture increases the tendency of the wheat to develop germ damage in later storage at as low as 12% moisture.

Early detection of damage and storage under anaerobic conditions are two possible means of limiting mold damage, the paper explained. Decrease in viability is the first detectable change in the deterioration of wheat. A simple colorimetric method for determining dehydrogenase activity, based upon the reduction of triphenyltetrazolium chloride to formazan, has been developed. Unfortunately, the relationship between viability and absorbence has been

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found to vary with variety, environment, and degree of mold infestation.

Carbon dioxide concentrations of 12% and above caused marked inhibition of respiration, of mold growth, and of the development of fat acidity in wheat respiring at 18% moisture in the presence of 21% oxygen. In contrast, decreases in oxygen tension (no carbon dioxide present) resulted only in a gradual decrease in respiration and suppression of mold growth.

A germination inhibitor obtained by growing A. flavus on a water extract of wheat has been isolated and found to be a heat-stable, dialyzable acid yielding at least five amino acids upon acid hydrolysis.

Proteins

"The Proteins of Wheat Flour" was the subject presented by H. S. Olcott, J. W. Pence and D. K. Mecham of the Utilization Research Branch of the U.S. Department of Agriculture.

Gluten as ordinarily prepared contains 5 to 12% lipides, and the physical properties of doughs and glutens can be affected materially by certain types of added lipides, it was explained.

Glutens from flour of widely varying baking properties are uniform in amino acid composition. Likewise, doughs reconstituted from a common starch and glutens from different flours, all baked into uniformly poor bread. Upon restoration of the soluble, nongluten proteins, however, varying degrees of improvement occurred. The nongluten proteins, particularly the albumins can thus modify the baking properties of glutens markedly and may contribute much to the variability among flours.

The nongluten proteins consist of at least three globulins and 11 albumins. The albumins appear to differ little in molecular weight but are electrophoretically distinct. As a group they contain appreciably more tryptophan and cystine than other wheat proteins. Proportions of the individual components in albumin preparations from flours of durum wheat differ characteristically from those derived from club and common wheat.

The elastic, cohesive properties of the proteins of wheat gluten are basically responsible for the characteristic porous structure of leavened baked products, but the chemical composition and structure responsible for these unusual protein properties are as yet ill-defined.

The limited solubility of gluten in suitable solvents has restricted the usefulness of the principal physicochemical methods of investigation. However, ultracentrifugal, electrophoretic, and viscosity studies suggest that gluten is a system of several highly interacting components or an extremely complex mixture of components differing gradually in properties from the more or less insoluble "glutenin" portion of gluten to the more soluble "gliadin" portion.

Gum gluten is thought to form only when flour is mixed with water and then mechanically worked. Some of the glutenin components appear to occur in complex with lipides in flour and to form additional complexes when flour is made into a dough.

Dough Chemistry

"Lines of Attack on Dough Chemistry" was the subject presented by Dr. J. A. Anderson and I. Hlynka of the Canadian Board of Grain Commissioners' research laboratory.

Rheological studies have now yielded a meaningful and coherent account, in reproducible and quantitative terms, of the behavior of unyeasted doughs, Dr. Anderson said. Changes that occur in doughs, with or without "improvers," when they are mixed or otherwise manipulated and during subsequent resting, can be explained by postulating a dynamic three-dimensional polymer network as the main feature of their chemical architecture. Protein molecules must comprise the main chains, but lipides and possibly carbohydrates, are also involved. Changes in rheological properties require postulation of the making and breaking of crosslinks; even when dough is in relatively stable condition, the equilibrium is doubtless dynamic. Crosslinking by hydrogen bonding seems most probable, but links of other types, such as disulfide bridges, cannot be excluded.

The key problem is to develop and subsequently to verify the network hypothesis by elucidating the crosslinking. Main lines of attack involve parallel studies of the effects of iodate and bromate on rheological properties, of the rates of disappearance of these "improvers" in the dough, and of the fate of sulfhydryl groups during the process. Iodate has an immediate effect, but bromate has a time-dependent effect. Proteases, now widely used in baking, are also uesful tools. Additional information is obtained by adjusting temperature, pH, and moisture, and by changing the timing and amount of work done on the dough. A comprehensive collection of facts bearing on the problem is gradually being built up, Dr. Anderson said, but it would be premature to claim that solution is in sight.

Carbohydrates

The carbohydrates of wheat and other cereal grains were examined

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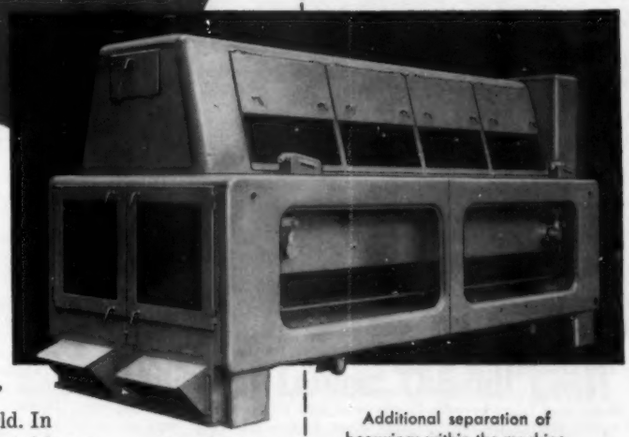

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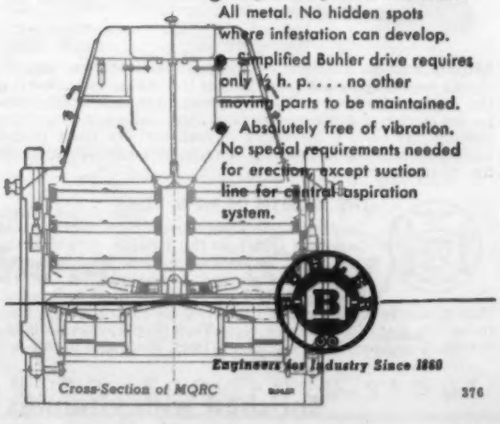

Cross-Section of MQRC

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by R. Montgomery and F. Smith of the Department of Agricultural Biochemistry, University of Minnesota.

The aqueous extract of wheat flour contains simple and complex carbohydrate compounds. Chromatographic analysis has shown that the simple sugars and oligosaccharides consist of D-fructose, maltose, sucrose, raffinose and oligosaccharides composed of glucose and fructose. The two sugars, sucrose and raffinose, present in high concentration in wheat germ, are very sensitive to the moisture content of the wheat kernel. A rise in the moisture content of the grain results in a change in the ratio of the two sugars as well as a decrease in the sum total of the two.

The pentosan, or hemicellulose, extracted from wheat flour with water is composed of L-arabinose and D-xylose which are united glycosidically to give a highly branched polymer. A similar pentosan is present in rye and barley flour and also in the "squeegee" fraction of wheat flour.

The aqueous extract of flour also contains glucofructosans, one of which is composed of units D-fructofuranose joined by 2,6-glycosidic bonds. The D-glucose is present in the polysaccharide in the pyranose form and together with one of the fructose units represents a sucrose template to which the remaining fructofuranose units are presumed to be attached by enzymatic synthesis in the plant. The structure of the glucofructosan, levosine, extracted from rye grain, has also been established and falls into the same structural pattern as the glucofructosan extracted from wheat.

Hydrophilic properties are conferred upon the barley grain by a polyglucosan which has gumlike properties. This carbohydrate polymer is composed only of D-glucose units which are joined by glycosidic bonds. Half of the bonds are of the 1,3-type and the other half are of the 1,4-type. A gumlike polysaccharide present in oat flour has been shown to be structurally related to the lichenin polysaccharides.

A number of the more complex carbohydrates do not occur in the free state. Thus, certain isolated polysaccharides are frequently soluble in water yet they cannot be extracted with water directly from the grain. A case in point is the glucurono-arabo-xylan extracted from the hulls of maize kernels. The relationship between structure and physical properties was discussed.

Fundamental studies of the chemical constituents are not only important for a further understanding of the present uses of cereal grains but also for the development of their industrial chemical usage, the paper concluded.

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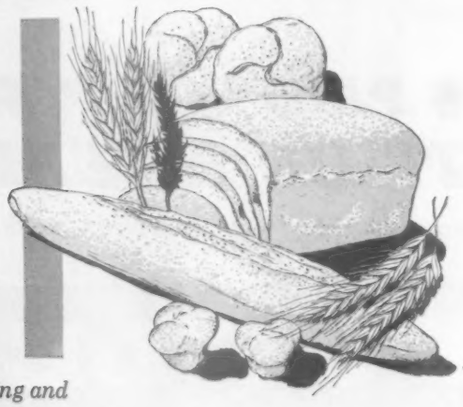

A Brief History of Milling and Baking by SCIENCE WRITER

CHAPTER X. *When New York and Philadelphia Were Milling Capitals*

THE DUTCH IN NEW AMSTERDAM

Nature blessed New York City with a wonderful harbor which is connected by sheltered waterways with parts of New England, New Jersey and upstate New York. The Dutch, who established New Amsterdam early in the 1600s, quickly realized the value of these geographical assets and, with typical foresight, acted.

Settlements grew up in Manhattan along the Hudson River as far north as Albany, on the flat lands in New Jersey and Long Island, and even at Hartford in Connecticut. Wheat growing was an important activity of the farms in the areas controlled by the Dutch. Soon wind and water mills appeared on Manhattan Island, now the heart of New York City, to process the grain which was shipped by the inland water routes to that center. The first was built in 1626.

A thriving export trade from New York harbor grew up in flour and hard breads. Some was sent to New England but much found its way to the West Indies where it was exchanged for molasses from which rum was made.

Milling was an extremely important part of New Amsterdam's commercial activity. This is not strange, however, as the center of wheat milling in those days was always close to the center of grain production. And, let's not forget that milling has been a necessary human activity since prehistoric times. Man is just not able to use raw wheatberries for nourishment.

THE BRITISH IN NEW YORK

In 1664 sovereignty over New York passed from the Dutch to the British. At about that time the city became a large and important milling center and wheat market. In fact milling bulked so large in the city's affairs that it was reflected in the design of its coat-of-arms. Even today the seal of the City of New York displays the sails of a windmill and two flour barrels. Wheat, flour and bread continued to be a vital part of New York's domestic and overseas commerce through the American Revolution and the Napoleonic period.

PHILADELPHIA, THE COLONIES' MAJOR CITY

Prominent as New York was in Colonial times it was not then the leading American city. That distinction belonged to Philadelphia. Leadership as a milling center passed from the former to the latter.

Because of a combination of fertile soil and thrifty, hard-working farmers, the lands around Chesapeake Bay and the Delaware River became the chief center of wheat growing in the colonies and in the world. Philadelphia, Baltimore, Wilmington and Richmond shared the milling and trading activity. After 1750 Philadelphia held the leadership in milling wheat for many years only to be overshadowed by Baltimore in the early 1800s.

Midway in the 18th Century wheat was the major cash crop of Pennsylvania. The Colony grew enough to feed its own population plus half as many more and still it was able to export about 50% of the crop.

WHITE FLOUR . . . WHITE BREAD . . . ENRICHMENT

Throughout this series of articles three themes are apparent: 1.) The milling of grains is an ancient and necessary activity because people cannot eat whole wheatberries. 2.) When wheat is milled to the fineness and whiteness demanded by today's consumers certain valuable elements are unavoidably lost. 3.) To overcome inescapable losses the vitamins thiamine, riboflavin and niacin and the mineral iron are restored to the flour or bread through the widely accepted practice of enrichment. Today's white flour and bread meet today's taste—and today's requirements for good nutrition.

The next chapter titled: "Milling Begins Moving Westward" will be published soon.

This is one of a series of articles which is being published in professional nutrition and dietetic journals, and which will be widely distributed for educational purposes. Reprints of this and all previous chapters are available without charge. Write to the Vitamin Division, Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada: Hoffmann-La Roche Ltd., 286 St. Paul Street, West; Montreal, Quebec.

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—BREAD IS THE STAFF OF LIFE—

1955 Crop Soft Wheat and Flour Characteristics

By H. M. Simmons

EDITOR'S NOTE: The following article is an excerpt from a talk by H. M. Simmons, chief chemist, Mid-West Laboratories Co., Inc., Columbus, Ohio, at a recent meeting of the Wolverine District of the Association of Operative Millers. Mr. Simmons presents a survey of new crop soft wheat and flour characteristics in the central states area.

As a whole, the 1955 soft wheat crop was harvested dry. We heard of no serious complaints due to smut or rust. The test weight indicated there was no serious damage. The average test weight was close to 59 lb. compared to about 57 lb. last year. Last year we had some mildew growth which seemed to reduce the test weight. The average moisture was below 14%. In fact, some mills found it necessary to use a little temper from the start on the new crop.

The protein on the new crop is lower in some sections and higher in others. If we were to draw a line along Route 40 through Ohio and Indiana, we could say that south of this line is higher protein and north is the lower protein. In Ohio the south half will average close to 10.75 to 11.0%. The average on the first 25 cars received by one grain company in Columbus averaged 10.98, the range being from 10.10 to 12.60. Most of these cars were from south of Columbus. Later cars received from north of the city averaged close to 10%.

The southern half of Indiana is similar to Ohio, the average protein being 11% or slightly above. The "pocket" area is a little lower—the average may be close to 10.6 or 10.75, compared to 10.0-10.4 last year.

The wheat samples received from Illinois indicated the protein might be a little lower, but flour samples received recently indicate a little higher protein, possibly even close to 10.5%.

Pennsylvania shows a wide spread, from 9.6 to 11.65. We are noticing white wheat being raised in Pennsylvania, which possibly accounts for some of the low protein. We believe as a whole the all-red wheats are

higher and should average close to 10%.

We now go back to the northern half of Ohio and Indiana which look very much alike in our protein survey. The average seems to be about 9.75 —northern Indiana may be a little higher.

The New York white wheat runs lower than last year by about three-quarters per cent. The average is about 8.45, compared to a little over 9.0% last year. Following this same trend, the Michigan white wheats show from ¾ to 1% lower than last year. The average seems to be close to 8.9, compared to 9.75 last year. The peculiar thing this year is there doesn't seem to be any low spot on the Michigan map. We usually think the "thumb" area will show low protein. There are some low proteins but also quite a few samples were above 10%. If there was any high section, the center section possibly would average a little over 9.0%, with Saginaw County being about the highest.

The 1955 soft wheat seems to mill nicely—at least we haven't heard too many complaints—and the flours so far as ash and protein is concerned seem to be equal to last year. The first flours we received seemed to be higher in ash, but in most cases the mills were able to make the necessary adjustments, so today our results indicate very good soft wheat flours in all grades.

On the Ohio flour, from the few mill stream analyses that we have had, it looks like the higher ash is at the end of the mill, or in the 5th break and the 6th and 7th midds. The extra short patent cake flours from several mills in Ohio run well below .30% ash. While we do not receive the large number of straight grade soft wheat flours from Ohio that we used to, due to the manufacture of special flours, we have had enough to indicate the ash range on so-called 95 to 97% flours from .37 to .41. This is very close to last year.

The protein and viscosity of course follow the protein on the wheat. From the south half of the state five mills showed, on so-called straight grade flours, an average of 9.10 protein, .38 ash, and 73 viscosity. Flours like this will make excellent cracker sponge flours. Flours from the northeastern part of Ohio are much lower. The proteins range from 7.75 to 8.0%, ash from .37 to .40, and viscosities from 44 to 55°. The north central and northwestern part of Ohio show a little higher than the eastern part. Proteins range from 8.25 to 8.6, the average ash around .39 and viscosities around 70.

Southern Indiana follows the same pattern as Ohio. Cracker flours range from 8.9 to 9.5 and viscosities from 80 to 90°. The north half of Indiana shows a little higher protein than the corresponding section of Ohio. The protein here runs from 8 6 to 8 85 with viscosities around 60 to 70°.

Before we leave Ohio we might point out the pressure meter reading and maltose figures are running quite low.

	Pressure meter readings— 6 hours	Mgs. maltose per ten grams flour
Richland Co.	250 mm.	160
Franklin Co.	290	180
Woods Co.	225	145
Miami Co.	194	130

This indicates the crop was harvested with very little sprouted wheat. However, for cracker sponge flours, you may need to add a little malted wheat flour.

Michigan, with the lower protein wheat, as was expected gave a lower protein and lower viscosity flour. An average of seven mills showed 7.5 protein, .385 ash, and 34° viscosity. With this low protein, low viscosity flour we also expected a high spread factor on the cookies, but so far this is not the case. The average spread on these flours was 9.13, with a minimum of 8.9 and a maximum of 9.35. This is far different from last year when the spread was from 9.50 to 10.0. These figures are the actual W/T, and not expressed as per cent. Samples of cookies from these streams have the straight sides, or resemble biscuits.

If we look at the edge of the cookies made from the 100% flour, we find there is a tendency to have high sides. If we look at cookies made from last year's crop, we notice they tend to flatten out at the edge. We thought possibly a reason for this may be the early harvest or a dry crop. Our pressure meter readings and maltose figures on several flours showed they were low.

	Pressure meter readings— 6 hours	Mgs. maltose per ten grams flour
Central and Eastern Michigan	150	88
	195	125
Northern Michigan ..	190	122
	250	155
Western Michigan ..	200	130
Last year's crop	350	220
On this particular 100% flour	245	155
On the 7th midds. ..	575	375

This indicated that high malt values did not increase the spread. Whether it was responsible for this type of cookie, I do not know. We do know that something is causing this type of cookie in certain streams.

Although the protein is lower on some cake flours, we have had very little trouble with the exception of some that ran down to 7.0 or 7.2% protein with viscosities around 25 to 30°. On these the cakes were good, but the volume was small. However, now most of these mills have been able to raise their protein at least to 7.75%.

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DAY SINCE 1881

EXCLUSIVE U.S.A. DISTRIBUTOR FOR PNEU-SPOUT

WOULD YOU

SHATTER HER DREAM?

Milady buys your self-rising flour or corn meal with a mental picture of the end result. When she specifies the brand, she's already counting the compliments.

To let this lady down once is to risk her good will and continued loyalty. Since the success of your product ultimately depends on her business, why take chances?

Best way to preserve brand loyalty is to stay with ingredients you know are the best. For example, it's wise to remember that practically all the self-rising flour and self-rising corn meal made during the past 16 years has been leavened with V-90. During those 16 years, the sale of these products has enjoyed a spectacular growth.

That is proof of dependable performance. That is the reason for the milling industry's remarkable allegiance to V-90. And that is convincing evidence that the outstanding leavening action of V-90 has consistently provided American homemakers with oven products they can be proud of.

So why take chances with your customers' loyalty? Don't risk the reputation of your product. Specify V-90 and be sure.

"THE ... WITH ..."*

V-90®

*Coated Anhydrous Monocalcium Phosphate

VICTOR CHEMICAL WORKS

155 N. WACKER DRIVE CHICAGO 6, ILLINOIS

Report Issued on Milling Test in Pacific Northwest

WALLA WALLA, WASH.—As a result of a commercial scale milling test, Pacific Northwest crop and agricultural authorities have recommended that commercial production of a wheat called P-80 be discouraged.

This was pointed out in a recent bulletin from the Pacific Northwest Crop Improvement Assn.

During 1955, a Pendleton, Ore., wheat grower harvested several thousand bushels of P-80. Eight years ago Rex-Alicel (P-80) was test milled and was rejected as being of poor milling and baking quality. Since then P-80 was increased by the Pendleton grower, and, since it performed well agronomically, it caused considerable interest.

Samples were submitted to the Western Wheat Quality Laboratory at Pullman, Wash. Preliminary information indicated the variety had fair milling characteristics but not as good as Elmar. It did appear to be somewhat better than the Rex-Alicel tested in 1947.

Accordingly, the wheat was test-milled on a commercial scale recently at the Pendleton plant of Igleheart Bros. Division of General Foods Corp. Several operative millers and cereal chemists were among those present for the test.

George Lowery, Preston-Shaffer Milling Co., Walla Walla, prepared a report on the test which represented the opinion of the millers and others. The report said, in part:

"The wheat was cleaned and tempered for 30 hours at 14.4% moisture in accordance with the standard treatment for white club wheat at this plant. The mill was started at

YOUR CONTROL CHEMISTS APPRECIATE THESE ENRICHMENT ADVANTAGES

Control chemists recognize these points of superiority in MERCK VITAMIN MIXTURES:

1. **Uniformly light in color.**
2. **All ingredients are so finely divided and thoroughly mixed that uniform distribution can be attained in every pound of flour.**
3. **Flow readily and feed easily in the customary feeders.**

Because of these advantages MERCK VITAMIN MIXTURES are preferred by so many quality control people in the industry. *And remember:* Enrichment adds a potent plus at the point of sale.

MERCK VITAMIN MIXTURES

For Flour Enrichment

Research and Production for the Nation's Health

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Manufacturing Chemists
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DAWSON 73
The LOW-DOSAGE *Spot Fumigant*

NOW IN 1-SHOT CANS
JUST **Punch and Pour**

in same fumigation ports now used: Discard can and move to next point. Dawson 73 in two-inch shot can carries knock-out strength of about a quart of conventional fumigant. No more pouring from shipping containers to applicator bottles . . . no wasted time . . . no fumigant lost . . . no broken glass. Your costs will be much less. Prove it to yourself. Order case of 48 cans Dawson 73 today.

The "LITTLE SQUIRT"
for MAXIMUM MILL EFFICIENCY

There's nothing like the "Little Squirt" applicator and Dawson 73 if you have a large mill. Used in many leading mills. Cuts costs substantially. Two men can fumigate average mill in two hours. No equipment to buy. No initial investment.

DAWSON'S FORMULA 73 Specially prepared for Spot Fumigation in Mills, Bakeries, Breweries, Etc.

DAWSON LOW-DOSAGE FUMIGANTS

FERGUSON FUMIGANTS
810 S. Florissant Rd.,
FERGUSON 21, MISSOURI
In Canada: Kipp Kelly, Ltd., Winnipeg and Toronto

7 a.m. with a normal feed of 253 bu. per hour to the first break. For a period of two hours, this wheat appeared to perform fair, even though the woolliness or Rex-like character showed from the start. At 9 a.m. the Rex-like character of the wheat became more pronounced. The product going to the purifiers began to carry some flour and consequently hindered good purification of the middling stocks. The bran was milling fairly clean while the shorts were not. The feed middlings were the poorest and contained the most pronounced woolliness. At 10 a.m. when the feed middlings were compared with the feed middling standard, it was found that far too much flour was being carried over for practical milling.

Flour Yield

"Flour yield measured for a three-hour period was 68.9%, compared to normal run on the mill of 73%. Millers felt that the bolting action was becoming progressively more sluggish and that on a 24-hour basis the yield would be considerably less than the 68.9% obtained during the three-hour period. It was also believed that a continued run would necessitate a reduction in feed at the first break. The net result would be less wheat milled in a 24-hour period and a greater than normal amount of wheat required to produce 100 lb. of flour.

"Several millers expressed the opinion that after witnessing the gradual deficiency taking place in this wheat's bolting action, future milling tests should be conducted on the basis of a three-hour minimum run on the mill."

It was agreed that commercial production of this wheat should be discouraged since its inferior quality would be detrimental to production of good quality wheats in the area.

TRONA
INDUSTRIAL AND AGRICULTURAL CHEMICALS

BROMOTOX*

The
LOW DOSAGE
SPACE
FUMIGANT
for
VAULT
TARPAULIN
WAREHOUSE
MILL
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Assures
- MAXIMUM RESULTS
- GREATER SAFETY
- MORE ECONOMY

Bromotox, a mixture of ethylene dibromide and methyl bromide, is an effective, safe and economical space fumigant. The stronger odor and lower dosage requirements of Bromotox result in greater killing power, increased economy and maximum safety. It is longer lasting, more penetrating and leaves no residual odor. Bromotox allows positive control of granary and rice weevils, Angoumois grain moth, confused flour beetle, Mediterranean flour moth, raisin moth, cheese mites and many other pests infesting grain, flour, rice, cheese and dried fruits. Available in cans packed twelve per case as well as 10, 50, 120 and 170 pound cylinders.

*TRADE MARK AP & CC

Other Eston Fumigants:

ESTON METHYL BROMIDE
The Versatile Fumigant

M-B-C FUMIGANT
Methyl Bromide with 2% Chloropicrin

A Product of
ESTON CHEMICAL DIVISION

American Potash & Chemical Corporation

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Midwestern Distributor

FERGUSON FUMIGANTS

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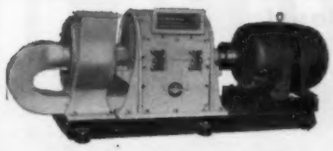
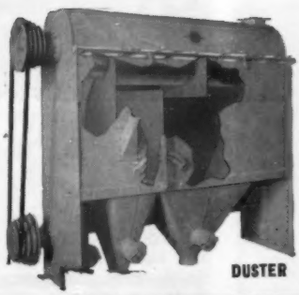
MODERN FORSTER EQUIPMENT PAYS BETTER MILL PROFITS

Each of these Forster machines for better flour milling does a specific job superbly well. Each was originated to meet a definite need for more efficient milling and cost saving. They are profit makers. Forster machines handle milling jobs from start to finish . . . wheat scouring, conditioning, feed grinding, feed finishing, dusting . . . plus elevating and conveying equipment, dust collection systems and bins. Call Forster for profit-making mill equipment.



HAMMER MILL—4 CAPACITIES

ELEVATOR HEADS, BOOTS, CONVEYORS, BINS



DUSTER

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FEED DRESSER

WHEAT CONDITIONER

CYCLONE SCOURER

MANUFACTURING FORSTER COMPANY

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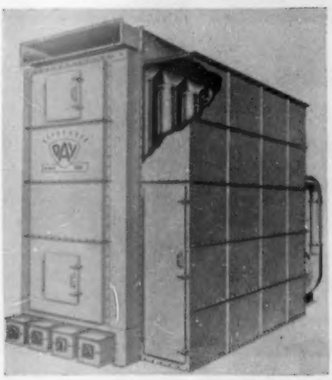
Worth Looking Into

New Products
New Services
New Literature

This reader service department announces the development of new and improved products, new services and new literature offered by manufacturers and suppliers. Claims made in this department are those of the firm concerned. Use the accompanying coupon to obtain the desired information.

No. 5305—Dust Filter Housing

All housed reverse jet Hershey type dust filters supplied by the Day Co., are now being furnished with a newly designed housing. The new housing construction features a walk-in access door and two inspection doors claimed to speed inspection of the operating mechanism. The cutaway section shows reverse jet filter tubes and square to round dust laden air inlets. Small access doors are located at the top and bottom of the filter chamber. These allow periodic lubrication and inspection of the gear-motor drive which operates the reverse jet air pressure blower and screw conveyor discharges. Company officials say that the walk-in access door provides convenient entry into the filter housing and allows maintenance or repairs to be made with greater ease and in less time. For further information check No. 5305 on the coupon, clip and mail it to the address provided.



No. 5279—Continuous Process Unit

The Cog Corp. announces features of its new impact-in-air comminutor designed for continuous process batching of products for various industries, including the feed industry. Units for size reduction of wet as well as dry products are available. Blending is also possible, according to the company's announcement. Other features claimed are: The unit incorporates a rugged spindle supported integrally with oversize bearings seated in line-bored housing for life-long alignment accuracy; "snap-apart" construction of all functional parts to permit stripping for rapid cleaning; rotor reversible on splined shaft for dual purpose blades or extra blade life; over-all construction based on sub-assemblies which provide minimum maintenance, maximum accessibility and many combinations in one basic unit; round-the-clock operation. Secure more complete details by checking No. 5279 on the coupon and mailing it.

No. 4031—Pink Wheat Identification

Ready identification of pink wheat is possible through use of Blak-Ray ultra-violet lights, according to Ultra-Violet Products, Inc. Pink wheat is mercury-coated grain unfit for human or animal consumption. By inspecting the wheat in a darkened room under the Blak-Ray lamp, the pink kernels of poisoned wheat stand out clearly,

according to the Ultra-Violet Products company. The Blak-Ray Model X-4 lamp is mounted over a moveable belt on which the wheat kernels are spread out for exposure to the ultra-violet rays. Pictured here is the inspection apparatus used by Union Equity Cooperative Exchange, Enid, Okla. For further information, check No. 4031 on the coupon and drop it in the mail.

No. 5284—Equipment Rental Service

National Equipment Rental, Ltd., has inaugurated a new service which enables acquisition of equipment for modernization, expansion or plant automation through rental arrangements. The firm purchases any type, make or model of equipment specified and leases it for a specified term. No down-payments are required, no chattel mortgages are filed and no conditional bills of sale are involved, the company says. They point out credit advantages and claim the service is an opportunity for tax savings. The company states its national plan is flexible and has liberal options for lessee equity. A brochure explaining details of the plan may be obtained by checking No. 5284 on the coupon and dropping it in the mail.

No. 5200—Weighing System

A technical reference, offered by Richardson Scale Co., describes and illustrates a weighing and handling system which utilizes a line of batch hoppers suspended from an elevated monorail. Under the remote control of one operator, the hoppers are automatically tare weighed, filled wtih multiple ingredients, net weighed and conveyed to a delivery point for discharge. The reference outlines the complete sequence of operation for the weighing, indicating and delivery cycles. One section, discussing control features, covers such things as pilot light indicators, weigh selector dials and the system's servo mechanism. Information on the automatic recording of tare, gross and net weights is also included. To secure the reference check No. 5200 on the coupon and mail it to this publication.

No. 5304—Dust Filter Bulletin

Published by the Day Co., bulletin No. 559 contains details of the firm's reverse jet dust filter. The 28-page bulletin has special pages outlining helps and aids in solving dust control problems. It contains schematic operating diagrams, performance curves for various types of dust, comparison chart of reverse jet vs. conventional type filter performance and air engineering data. Sections are devoted to the planning and arrangement of filters to meet specific requirements and self-adjusting reverse jet blow rings are explained. The indexed bulletin is available without charge by checking No. 5304 on the coupon and mailing it.

No. 4030—Cleated Conveyor Belt

A cleated conveyor belt for incline or decline conveying has been announced by the A. J. Sparks Belting Co. The cleat is fabric reinforced and has no joints, cracks or gaps, the company says. The cleat and the body are on solid piece. The cleats can be made in any height, width or spacing

and as flexible or stiff as desired. They will flex around pulley diameters, compatible with the weight of the belt. Colors available are white, tank or black. They can be supplied in rubber, neoprene or special compounds for resisting various materials. The company notes that there are no cracks or crevices where bacteria or other undesirable matter can accumulate, and the smooth curves of the cleat make cleaning simple. There are no rivets, bolts or nuts in the belt. For further details check No. 4030 on the coupon and drop it in the mail.

No. 5274—Pallet

The Bakelite Co., division of Union Carbide & Carbon Corp., has announced a new type of materials handling pallet weighing 28 lb. and molded of Bakelite polyester resins reinforced with Fiberglas to support 3,000 lb. of working load. Claimed to be resistant to oils, grease, acids and alkalies, the pallet has a surface that is easy to keep clean and sanitary by steam sterilizing at temperatures up to 325° F. Nine hollow legs molded in one strong piece with the platform they support are spaced to allow a four-way approach for fork lift trucks. Nested together in the hollow legs, 100 of these pallets stack up to a height of only 7 ft. 8 in., and occupy only 102 cu. ft. of storage space. Secure more complete details by checking No. 5274 on the coupon and mailing it.

Send me information on the items marked:

- ☐ No. 4030—Conveyor Belt
- ☐ No. 4031—Wheat Identification
- ☐ No. 5200—Weighing System
- ☐ No. 5274—Pallet
- ☐ No. 5279—Continuous Unit
- ☐ No. 5284—Rental Service
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The Northwestern Miller

P. O. Box 67,

Reader Service Dept. Minneapolis 1, Minn.

Home-made Blower Unit Used to Keep Wet Grain From Heating

GREAT BEND, KANSAS — "Two minutes, 55 seconds on that one," Fritz Zutavern said as he stepped away from the blast of the blowers. "That's a good deal, pulling a gallon of fumigant through a 12,900-bu. elevator in that time. That should prove something."

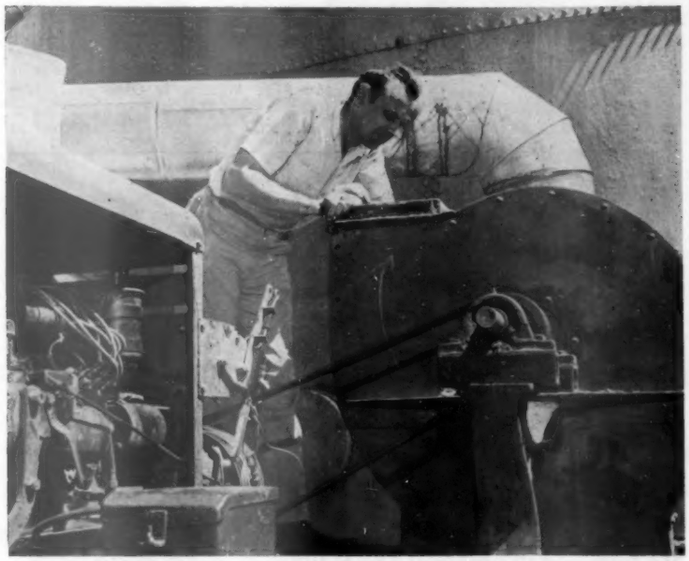
He indicated the roaring twin 36-in. industrial blowers joined in unison to provide double pulling strength and draw fresh air through an 89-ft. high concrete grain tank at the rate of 2,230 cu. ft. per minute.

For the test to determine just how speedily the air was being taken from top to bottom, A. J. Zelenka, plant superintendent at the Walnut Creek Milling Co. here, rode the lift to the top with a gallon can of carbon tetrachloride and carbon bisulfide, and on a signal from Mr. Zutavern at the bottom, he poured it through an opening into the 16-ft. diameter tank.

With his nose into the blast, Mr. Zutavern attentively sniffed and kept an eye on his watch until he smelled the fumigant-laden air roaring past his nose. Mr. Zelenka, meanwhile, came down from the top and busied himself checking the bearings on the 1-15/16 in. drive shafts that provide energy through three and five-groove pulleys and twin four-strand V belts attached to a 70 horsepower industrial gasoline engine. A single shaft from the engine provides power to the blowers at either end of the truck bed.

Mounted on Truck

The whole affair is mounted on a 1935 1½-ton truck with long wheel-



AERATION EQUIPMENT—The mechanism of connecting the industrial blowers to the 70 horsepower engine is shown above. The three and five-groove pulleys and the twin four-strand V belts power the exhausts. Note arrow chalked on blower casing and 13-in. pipe leading past Fritz Zutavern's left shoulder into the side of blower. The whole apparatus is mounted on a completely maneuverable truck. The truck and its cargo can be moved anywhere around the Walnut Creek Milling Co. elevator storage area at Great Bend, Kansas, for use in drying and fumigating stored grain.

BEST PRICES FOR THE BEST QUALITY MILLING GRAIN...

KEPT IN TOP CONDITION WITH

HOT SPOT DETECTOR SYSTEMS

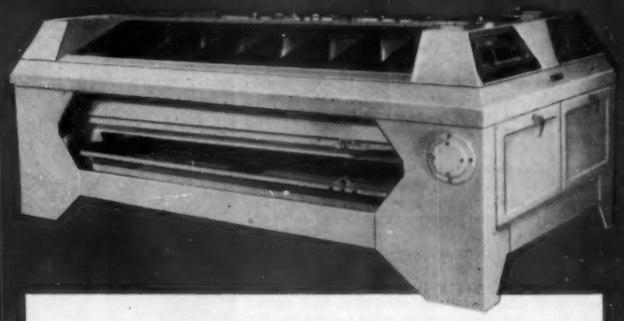
No problem to keep milling grain at top quality by knowing condition of grain; guiding safe storage operations through temperature control to prevent spoilage. Our systems detect slightest heating caused by moisture, insects, dirt . . . keeps grain in top quality.

HOT SPOT DETECTOR, INC.

214 THIRD STREET • DES MOINES, IOWA

Product of World-Wide Experience in Mill Engineering...

THE WORLD'S FINEST PURIFIER



This high-capacity machine has set new standards in efficiency of purification . . . in simplicity and accuracy of control.

FOR THE MAXIMUM YIELD OF CLEAN MIDDLINGS WITH THE MINIMUM ASH CONTENT THE SIMON ALL-METAL TYPE S PURIFIER IS THE FINEST MACHINE AVAILABLE.

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MILL COGS

We make ALL kinds. Specialize in "Ready Dressed" cogs which are READY TO RUN the moment driven and keyed. Write for circular "DW" and instruction sheets free.

The N. P. Bowsher Co., South Bend, Ind.

PAPER SACKS FOR MILLERS

The Chatfield & Woods Sack Co.
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One machine - or a mill-full - here's the COMPLETE SERVICE

'Pneu-Flow' can be used for smut department or mill. This shows a line of mill system cyclones.

'Pneu-Spout.' Easily-erected, versatile, sanitary, space-saving metal spouting.

'Pneu-Roll.' With 'Rollomatic' control sanitary stream lining, and ever-accurate setting. 'Duplex' chain drive cuts vibration.

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OF ROCHDALE, ENGLAND

WORLD-RENOWNED Robinsons. A *complete* service. Milling equipment and planning that's way ahead. (Depend on Robinson genius to do the whole job.) Research—design—manufacture—installation. Order one machine . . . two . . . a mill-full, you're sure of that *complete* Robinson service.

Milling engineering is more—much more than machinery. (Robinsons know that.) It's fresh, workable ideas . . . the ability to understand thoroughly *every* aspect of this essential world trade. (And Robinsons do.) Go to Robinsons with a milling problem and they'll provide the answer. See how Robinsons take a keen, lively interest in every project.

The answer probably lies in one of the many revolutionary Robinson developments that has come from their Research Department over recent years. (Developments that are rapidly changing the face of milling.) There's 'Pneu-Flow' — choke-proof pneumatic conveying for mill and smut department.

In the smut department 'Pneu-Flow' works with specially-designed, all-metal machinery. From Robinsons, too, comes 'Pneu-Roll' rollermills — streamlined, sturdy . . . extra sensitive (other important developments include the Robinson Plansifter with high-capacity and quick release arrangement) and 'Pneu-Spout' — easily-erected, versatile, space-saving metal spouting.

Far-reaching research linked with a deep understanding of your needs is the basis of Robinson fame—providing you with a complete service.

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65 MARKET STREET, TORONTO 1, ONTARIO *Telephone: Empire 6-5903*

base. "The truck cost us $75 and we spent $250 for the engine to power the blowers which came out of our own mill," Mr. Zelenka explained. He said the truck frame was bolstered with six-by-sixes and covered with planks to support the weight of the powered machinery.

"We can drive the truck and the blowers anywhere we want around the place. There are 11 tanks ready to be pumped out," Mr. Zelenka said as he pointed to the short sections of metal tubing sticking out from each tank about 10 ft. from the ground.

"We got the idea from a government practice of hooking small blowers to individual steel tanks to pull air through and keep them from getting too hot inside. The idea has been used on ships too," Mr. Zutavern added.

The pair cut 8-in. holes through the 6-in. concrete walls of the 11 tanks, and inserted 10 ft. of 8-in. perforated irrigating casing inside. The 22-gauge casing was purchased in 3-ft. sections "so we decided to have 9-ft. of perforated casing inside the tanks and 1 ft. of plain casing extended outside."

After cementing the casing into the walls, Mr. Zutavern and Mr. Zelenka capped the extensions to keep out birds and dirt. They next rigged 8-in. flexible exhaust tubing to plant-made spouts leading into the first blower. Since the blower openings at the sides are 13 in., reducer spouts had to be fashioned to adjust to the 8-in. tubing.

Gets Double Thrust

The air is drawn through the plain casing, down through the flexible tubing and into the side of the first blower at the rear of the truck where it is given an additional thrust through the top exhaust hole through the 13-in. casing into the blower mounted at the front of the truck and finally exhausted vertically into the open air.

The flexible tubing is attached to a tank with a metal collar slipped over the end of the tubing and the casing. Two quarter-inch stove bolts tighten the connection. Inch-wide masking tape is used to make certain the sleeve is tight. "It's the cheapest easiest thing we've found to seal the joints," Mr. Zutavern said.

Wet Grain Needs "Turning"

During the 1955 harvest much of the Barton County wheat cut was high in moisture content. Wheat in tanks by volume is 60% grain and 40% air. Elevator men usually "turn" grain from one tank into another at

This Bottle

WILL HELP KEEP YOUR WAREHOUSE

RODENT FREE!

The LARVACIDE Wick Bottle

It's as easy as that.

Simply insert soft string into the LARVACIDE bottle, letting part hang outside as "wick".

Won't bother humans, but hour after hour, day after day, it will release just enough LARVACIDE fumes to keep rodents OUT. They don't like even a small whiff of LARVACIDE.

One bottle takes care of 500-800 sq. ft. of space. Just place them at convenient points in accordance with instructions.

Write for Bulletin No. 1004.

Read what MELVIN LABORATORIES, Memphis, Tenn. write regarding their experience with the LARVACIDE wick bottle in a large Southern rice mill:

"During December when rats drive indoors for food, by placing 12 bottles at strategic points in a warehouse of 4,000 square feet, the building was kept practically free of rodent entry . . . at a cost of approximately $12."

AEROSOL LARVACIDE offers the new, easy way to have all the advantages of LARVACIDE without the labor of application. Just open a valve and the AEROSOL discharges into fog under its own pressure.

Kills every kind of grain and mill insect, including egg, larva and pupa stages. Penetrates cracks, stock *and grain kernels.* Your fumigation for insects takes care of rats and mice—drives rats out to die on open floor. No carcass nuisance. No waiting—and hoping—as with baits.

Write for full information about AEROSOL LARVACIDE.

Above all—Use LARVACIDE to fumigate your stored grain. LARVACIDE's kill includes egglife inside kernels—and LARVACIDE is ECONOMICAL.

PESTMASTER Methyl Bromide with or without LARVACIDE as warning feature. An old reliable space fumigant with a variety of uses, including box car treatment. Cylinders: 10 to 400 lbs. and 1 lb. cans, 24 to carton.

LARVABROME 80% methyl bromide, 20% LARVACIDE. For general and space fumigation where tightest sealing is not possible. Comes in cylinders: 50 to 400 lbs.

Write for literature on these reliable LP *products.*

Larvacide Products, Inc.

117 Liberty Street, New York 6, N. Y.

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Need New Rolls?

In addition to our roll corrugating and grinding service for the flour milling industry, the Twin City Machine Co. also supplies new rolls, and we will be pleased to receive your inquiries.

TWIN CITY MACHINE CO.

Roll Corrugating and Grinding New Rolls

527 Second Avenue, S.E. Minneapolis, Minn.

JONES-HETTELSATER CONSTRUCTION CO.

Designers and Builders for Milling Companies

1911 Baltimore Ave. KANSAS CITY 6, MISSOURI

night to try to prevent damage due to wetness.

"Wheat suffers heat damage and will be graded down if the temperature reaches 120°. The wheat berries are killed by too much heat and if there is 14% moisture the heat damage will work all the way through the tank. One way to keep the grain dry and prevent its becoming hot is to keep the air moving through the tanks," Mr. Zutavern added. He said that some tanks have thermal cable that enables the elevator men to keep a check on the wheat temperature all the way down.

Since the Walnut Creek tanks are conically shaped at the bottom so the grain can be emptied with ease, the perforated casing lies along the sloping tank bottom.

Once Hit by Tornado

The Walnut Creek mill has an impressive history that includes being hit by a tornado in 1916 which leveled all but the old section next to the tanks. "We use it now as a sheet metal shop. In this business we make all our own tubing and spouting," Mr. Zelenka explained. Across south Main street, also U.S. Highway 281, stands the flat top weighing office.

"That used to be a two-story place until the tornado sheared off the top floor," Mr. Zutavern said with a grin. The concrete tanks, built in 1922, have not had to survive a tornado—Great Bend has not had one since then.

Besides its grain storage business the mill's main work now is the manufacture and sale of formula feeds.

Mr. Zutavern has been general manager and Mr. Zelenka superintendent since 1952. Mr. Zutavern came here 16 years ago and Mr. Zelenka is a veteran of eight years.

"We think the aeration experiment will pay off handsomely. It will save a lot of time and money turning the grain," they said.

——BREAD IS THE STAFF OF LIFE——

AOM District No. 5 To Meet Oct. 28-29

ST. LOUIS — The Scott County Milling Co. will be host to District 5 of the Association of Operative Millers at an open house at its mill in Sikeston, Mo., Oct. 28-29, it was announced here recently.

W. C. Bowman, president of the Scott County company, has issued an invitation to the AOM members for the morning of Oct. 29. They will view the diversified operations at the plant, including flour milling, corn milling, feed manufacturing and grain handling facilities.

On Oct. 28 the group will attend a buffet supper at the Sikeston Country Club, and following the mill tour Oct. 29 members will attend a luncheon at the Rustic Rock Inn. The district business session will follow.

——BREAD IS THE STAFF OF LIFE——

Mill Chemist Named

CLIFTON, N.J.—James E. Sawyer was recently appointed chemist and director of plant sanitation, The New Jersey Flour Mills Co.

He formerly was with Weston Biscuit Co., Passaic, N.J., serving as chemist and later as supervisor of sanitation.

Mr. Sawyer has been a member of the American Association of Cereal Chemists and is now a member of the National Association of Bakery Sanitarians. He is a graduate of the University of Florida, Gainesville, where he received the degree of B.S. in agriculture.

PENETRATION OF MOISTURE

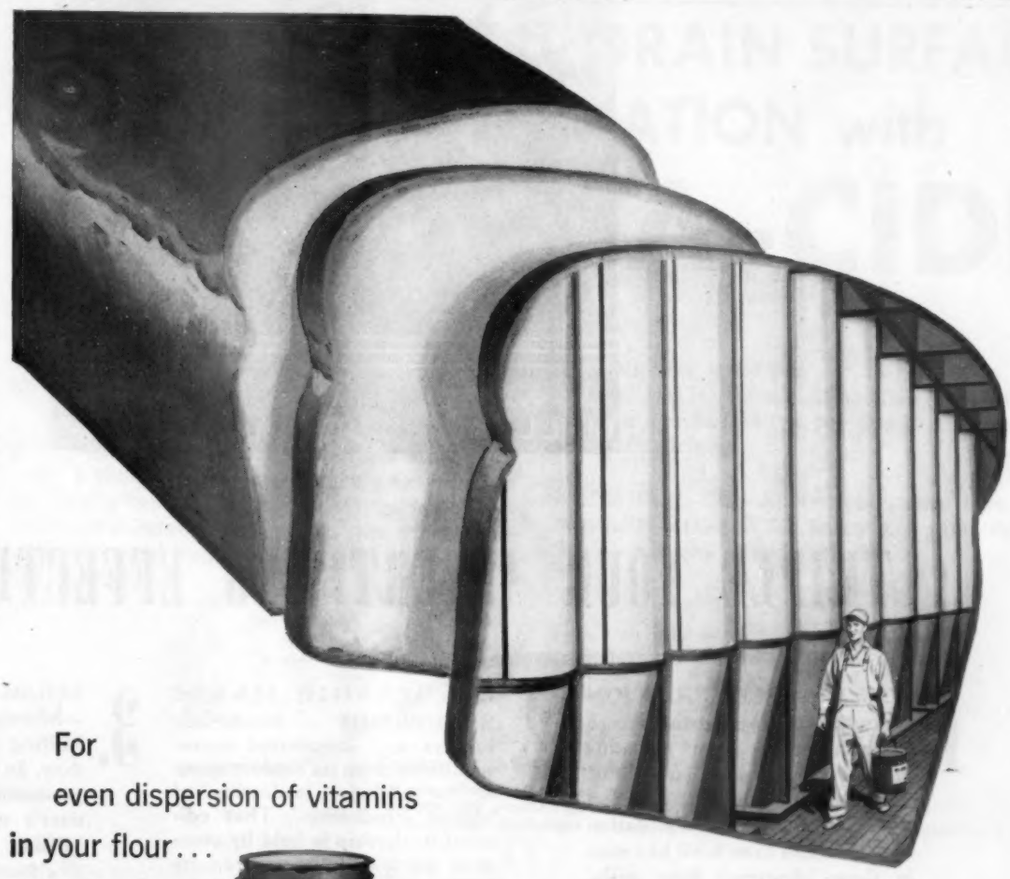
(Continued from page 1a)

prevented further stain penetration. By placing the kernel on a wetted wick, specific portions were wetted and studied. Using this technique, he found that if the kernel were wetted on the crease side, the stain would penetrate, whereas if wetted on the back, penetration could not be noted for some time. It appears that the moisture will readily move up the crease toward the germ end but will not move significantly from the back to the crease. Haltmeier was able to show, by removing successive layers from the outer surface, that it is the nucellar or hyaline layer that prevented moisture penetration through the bran coat.*

*J. J. C. Hinton, Cereal Chemistry 32:296 (1955), found that by measuring the rate at which water is absorbed from a capillary tube in contact with wheat kernels from which testa, hyaline layer and aleurone layer were successively removed, it was shown that the testa is the layer offering greatest resistance to water entry.

Fritsch (7) used iodine solutions to study the wetting of wheats. Iodine in solution complexed with starch to form a dark purple color. He obtained results similar to Haltmeier and, by use of radium solutions, was able to show a similar stain pattern.

Fritsch noted that on submerging wetted wheat in an oil, air bubbles could be seen leaving the micropile. He felt that this was evidence in support of the Capillary Theory postulated by Gehle. Gehle (9) believed that water penetrates wheat by a capillary action into air spaces between the bran and endosperm and



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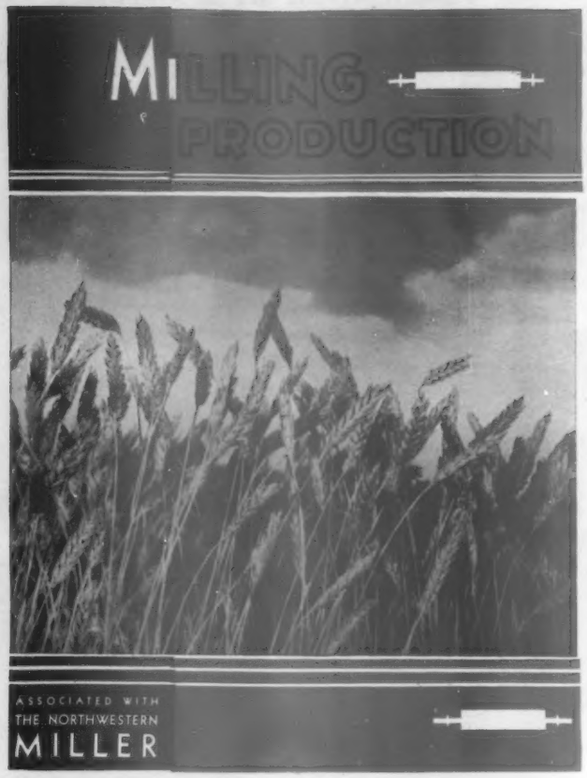

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through cracks in the endosperm. Such a mechanism would provide a theoretical basis for the much-discussed vacuum conditioning.

Schafer (21), on the other hand, seriously questioned this theory and felt that these capillary forces cannot sufficiently account for the rate of movement of moisture into wheat.

The mechanism of moisture movement into wheat is an unsolved problem worthy of much further study. Such research will be necessary to help the miller understand which conditioning techniques are sound and which are not.

There are two objections to the aforementioned stain techniques. The major one is that the wheat is wholly wetted before the stain has completely penetrated, and thus it would appear that the stain does not actually follow water but moves into the wheat at a different rate. Some method of following directly the movement of water would therefore be desirable. Another objection is that these stains probably form chemical or adsorption complexes with the endosperm, which may alter the nature of further moisture penetration. Despite these objections, work using stains has provided us with supplementary information which amplified the knowledge obtained using other more direct methods.

Iodine Vapor Studies

Ugrimoff (23) has developed the most direct experimental technique to date to study the movement of moisture into the wheat kernel. The kernels are wetted with water and, after a fixed period, are sectioned and exposed to iodine vapors. The iodine stains the wetted starch from yellow to blue-black depending on the moisture content. Thus an indication is gained not only of the precise location of the water but also of the actual moisture content.

The following pattern of penetration was noted (Fig. 2): Dark spots which appeared at the corners of the germ, expanded into a dark line separating the germ from the endosperm. This area gradually widened and moved along the underside of the bran particularly in the area of the crease. The whole kernel gradually darkened and the germ end became intensely dark until finally the entire endosperm was dark. Ugrimoff ran some very interesting experiments with the iodine vapor technique on partially wetted kernels. Grains wetted only at the germ end followed the normal pattern but those wetted at the brush end took several hours before any staining was observed within the grain. These results are similar to the wick tests run by Haltmeier using the stain technique.

Jones (12) noted an increase in rate of penetration into the endosperm of decorticated grains. The mode of penetration was also quite different since, with branless kernels, an even penetration through the entire surface, rather than merely at the germ end, was noted.

Factors Affecting Moisture Absorption

Buré (3 and 4) at the French School of Milling used the iodine vapor technique extensively to study the various factors governing tempering of different wheats. Fig. 3 shows the results of wetting Marquis (hard red spring wheat) under various conditions. Note that temperature and time are mutually dependent variables and that, as the temperature increases, time for complete wetting is shortened. Buré also noted that as the temperature exceeded 60° C. the mode of wetting became more uniform throughout the grain and less confined to the germ area. Use of steam resulted in an even penetration over the entire surface. This may significantly reduce tempering time. Similar experiments using a domestic French wheat showed that these wheats absorbed moisture in the same manner but more rapidly than hard red American wheats.

Fraser and Haley (6) summarized the factors involved in wheat absorption as follows:

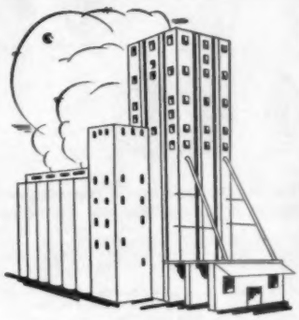
(a) Temperature—Increasing temperature and time will raise the absorption rate of water into all wheats.

(b) Wheat type—Soft wheats absorb moisture more rapidly than hard wheats. Winter wheat varieties exhibit more rapid absorptions than spring wheat varieties. European wheats absorb more moisture than American wheats of the same class.

(c) Endosperm character—Vitreous endosperm will absorb moisture less rapidly than starchy, mealy endosperm.

(d) Previous treatment—Scouring, brushing or washing tends to increase the rate of moisture penetration.

(e) Grain grade — Low grade



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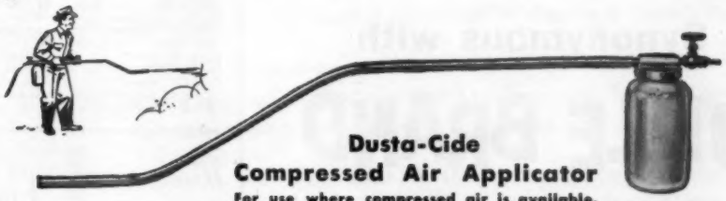

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grains tend to absorb moisture more rapidly than top grade wheats.

(f) Kernel size—Large kernels absorb water less rapidly than will small kernels.

Conclusions

Essentially, this is what is known about moisture penetration. Water tends to move along the outside surface towards the crease and along the crease to the germ end. The micropile is the apparent site of entry to the interior of the kernel. The moisture moves along the nucellar and aleurone layers next to the germ and bran and then less rapidly into the endosperm of the grain. The layer that prevents the penetration of moisture directly into the wheat kernel is not the outer bran layer but the aleurone or hyaline layer. The mechanism for the movement of moisture into the endosperm is not established. It may be due to a capillary action or perhaps to an absorption phenomenon. As temperature rises the rate of penetration increases although the initial penetration is not affected by temperature. The wetting of the endosperm produces a swelling and sets up internal pressures that rupture the outer coat of the seed and may lead to permanent alteration of the physical structure of the endosperm. This may account for the changed milling behavior of weathered grain, as well as wetted and dried grains.

It is obvious that much essential information is lacking. Certain factors affect moisture penetration, and a general pattern for the movement of water into grain has been indicated. How these observed changes account for the altered physical properties and, hence, the milling and handling characteristics of wheat is unknown. It is not even certain just what physical and chemical alterations are desired in tempering and conditioning. Further study of the mechanism of moisture movement and the ultimate changes in the chemical components responsible for so-called "mellowness," should help solve the present riddle.

While much information has been obtained in the past few years concerning what happens in the wheat kernel during tempering and conditioning, there still is much ground work to be done before the miller can hope to change the art of grain tempering to a science.

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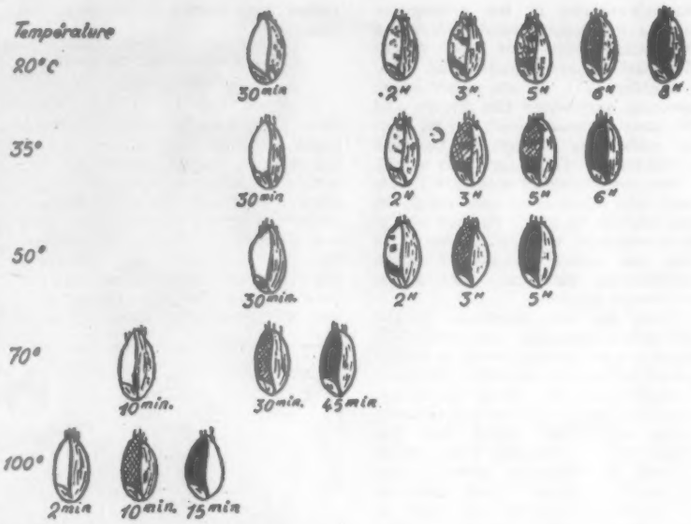

FIGURE 8—Diagrammatic representation of effect of temperature and time on staining of damp Marquis wheat by iodine vapor (Data of Buré, 3).

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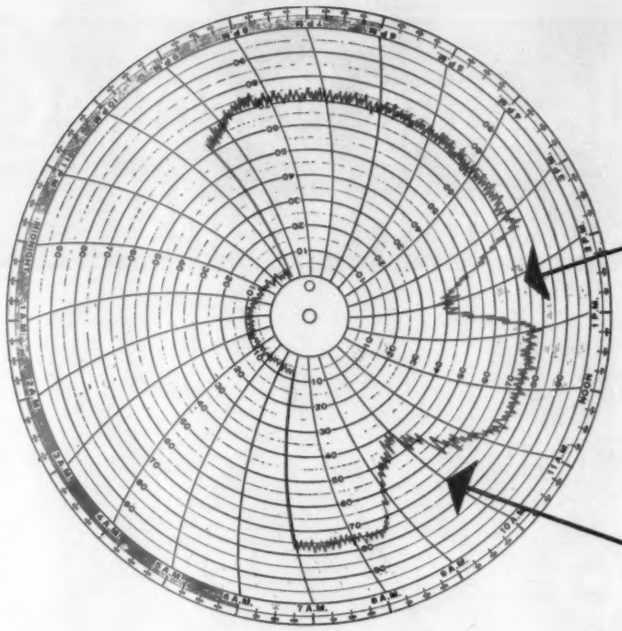

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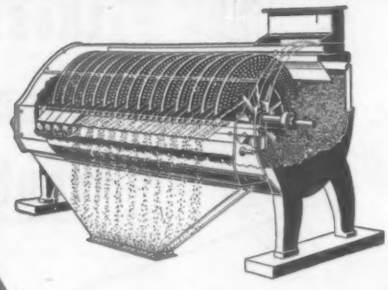

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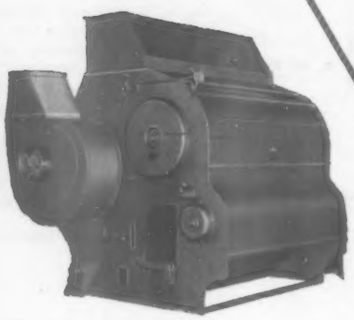

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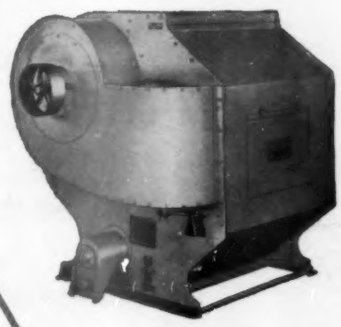

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